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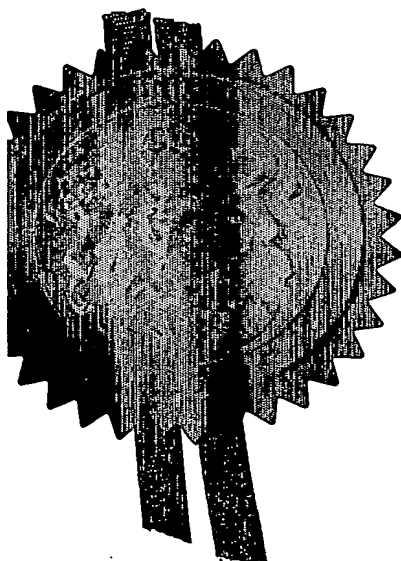
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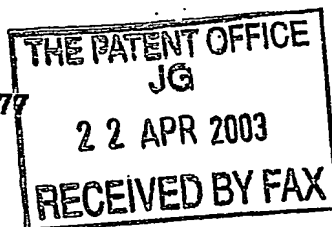
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1777

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1. Your reference

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2. Patent application number

(The Patent Office will fill in this part)

0309038.8

22 APR 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*Specialised Petroleum Services Group Limited
Arnhall Business Park

Westhill

ABERDEEN

AB32 6UF

8615064001

UK

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Downhole Tool

5. Name of your agent *(if you have one)*

Kennedys Patent Agency Limited

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Floor 5, Queens House

29 St Vincent Place

GLASGOW

G1 2DT

Patents ADP number *(if you know it)*

08058240002 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country

Priority application number
*(if you know it)*Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
*(day / month / year)*8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if*

Yes

a) *any applicant named in part 3 is not an inventor, or*b) *there is an inventor who is not named as an applicant, or*c) *any named applicant is a corporate body.*
See note (d))

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Continuation sheets of this form

Description 12

Claim(s)

Abstract

Drawing(s) 2

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature
KENNEDYSDate
18 April 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Arlene Campbell

0141 226 6826

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1 Downhole Tool

2

3 The present invention relates to downhole tools for use
4 in oil and gas wells and in particular, though not
5 exclusively, to a downhole tool for selectively catching
6 drop balls in a well bore.

7

8 It is well known in the art to use drop balls to perform
9 functions within a well bore. Resilient balls, typically
10 made of rubber, have been used to wipe the inner surface
11 of the well bore or tool string as the ball moves
12 downwardly or to separate fluids. Hard balls, typically
13 made of steel, are used to reset tools by blocking flow
14 through the tool and by a build up of pressure, causing
15 movement of one part of the tool in relation to another.
16 An example of such a tool is a circulation tool, wherein
17 radial ports are provided in the tool body and in a
18 sleeve within the tool body. The sleeve is fixed in
19 position with the ports misaligned so that fluid flow is
20 initially through a central bore of the tool. A drop ball
21 is released into the tool string and by sealing against
22 the sleeve, causes the sleeve to move relative to the
23 body. On movement the radial ports align and fluid is now

1 jetted radially from the tool. Improvements to these
2 tools have been on proving mechanisms where the ball can
3 fall through the tool so that the tool can be cyclic in
4 operation.

5
6 Once a drop ball is released from a tool or has completed
7 its function in a well bore it is necessary to catch or
8 retain the drop ball in the tool string so that it may be
9 brought back up to the surface. Simple ball catchers
10 merely comprise a bar or pin extending across the central
11 bore of the tool string providing a bypass for fluid but
12 preventing the balls from travelling any further. The
13 main disadvantage of such catchers are that after a
14 number of balls are caught fluid flow is impeded as the
15 fluid has to travel in a tortuous path around the balls.

16
17 US 5,127,472 discloses a ball catcher which allows fluid
18 flow around the balls, by providing a tube within the
19 tool string into which the balls locate. The tube
20 includes radially ports so that fluid can flow from the
21 central bore out of the tube, into an annulus between the
22 tube and the tool string. This ball catcher is limited to
23 operating only with resilient balls. Further this ball
24 catcher cannot be used in a tool string where a tool
25 located below the ball catcher requires to be operated by
26 a ball.

27
28 Applicants co-pending UK Patent Application 0308080.1
29 discloses an actuating mechanism wherein drop balls can
30 actuate a first tool in a tool string, then be released
31 and actuate a second tool below the first tool. The main
32 disadvantage of this mechanism is that the second tool
33 must be operated at the time the drop ball is released

1 from the first tool. This limits the Application to use
2 in sequentially operated tools.

3

4 It is an object of the present invention to provide a
5 ball catcher for use in a tool string which selectively
6 retains drop balls or allows them to pass through the
7 catcher.

8

9 It is a further object of the present invention to
10 provide a ball catcher for use in a tool string which
11 includes a bypass for fluid and allows selected drop
12 balls to pass therethrough.

13

14 It is a further object of at least one embodiment of the
15 present invention to provide a ball catcher for use in a
16 tool string which includes a bore which a wireline or
17 tubing deployed tool can pass therethrough.

18

19 According to a first aspect of the present invention
20 there is provided a ball catcher for selectively
21 retaining drop balls in a tool string, the ball catcher
22 comprising a substantially cylindrical body having a
23 central bore running axially therethrough, at least a
24 portion of the central bore being restrained to a first
25 and a second bore running axially therethrough, the first
26 and second bores being parallel and partially overlapping
27 to provide a channel therebetween and wherein the first
28 bore includes restriction means at an end thereof.

29

30 Thus a ball of a first diameter falling into the first
31 bore will be retained if the diameter is greater than the
32 width of the channel. If the first diameter is equal to
33 or less than the width of the channel it will move to the

1 second bore and be released from the catcher. The second
2 bore provides free passage through the catcher for fluid,
3 and selected drop balls.

4

5 Preferably the portion of the central bore includes an
6 entry port. More preferably the entry port has a first
7 aperture equal to the diameter of the first bore and a
8 second aperture having a diameter less than the diameter
9 of the first bore, the apertures being aligned with the
10 first and second bores respectively. In this way larger
11 balls are directed towards the first bore for retention
12 in the catcher, while smaller balls can fall through the
13 second bore.

14

15 Advantageously the entry port is inclined with respect to
16 the central bore. In this way balls can run into the
17 first aperture.

18

19 Preferably the second aperture has a diameter
20 substantially equal to the width of the channel.

21

22 Preferably the restraining means is a third bore
23 coaxially aligned with the first bore and having a
24 diameter less than the diameter of the first bore.

25

26 Advantageously the second bore is located centrally on
27 the body. Thus the central bore and second bore may be
28 coaxial. Such an embodiment provides for passage of a
29 wireline or other tubing deployed tool through the ball
30 catcher.

31

1 According to a second aspect of the present invention
2 there is provided a method of selectively retaining drop
3 balls in a tool string, comprising the steps:
4
5 (a) inserting in a tool string a ball catcher including
6 a first bore having retaining means and a second
7 bore passing therethrough, the bores including an
8 overlapping portion to provide a channel
9 therebetween;
10 (b) dropping a first ball of a first diameter through
11 the tool string;
12 (c) directing the first ball into the first bore; and
13 (d) retaining the first ball in the first bore.
14
15 Preferably the method further includes the steps of:
16
17 (e) dropping a second ball of a second diameter, the
18 second diameter being smaller than the first
19 diameter through the tool string;
20 (f) directing the second ball into the first bore;
21 (g) passing the second ball through the channel into the
22 second bore; and
23 (h) releasing the second ball from the ball catcher into
24 the tool string.
25
26 Optionally the method may further include the steps:
27
28 (e) dropping a second ball of a second diameter, the
29 second diameter being smaller than the first
30 diameter through the tool string;
31 (f) passing the second ball through the second bore; and
32 (g) releasing the second ball from the ball catcher into
33 the tool string.

1

2 Further the method may include the step of passing a tool
3 through the second bore into the tool string below the
4 ~~ball-catcher.~~

5

6 Preferably the method includes the step of actuating a
7 tool above the ball catcher with the first ball.

8 Preferably also the method includes the step of actuating
9 a tool below the ball catcher with the second ball.

10

11 Preferably also the steps may be repeated in any
12 sequence. Thus a first tool located above a second tool
13 can be actuated after the second tool is actuated.

14

15 It will be appreciated although reference is made in
16 relative terms to upper and lower, top and bottom, that
17 the present invention could be used in a well bore which
18 is vertical, inclined or horizontal wherein the drop
19 balls are carried by fluid pressure.

20

21 An embodiment of the present invention will now be
22 described, by way of example only, with reference to the
23 following drawings of which:

24

25 Figure 1 is a cross-sectional view through a ball
26 catcher according to an embodiment of the present
27 invention;

28

29 Figure 2 is a view through the ball catcher of
30 Figure 1 from above;

31

32 Figure 3 is a sectional view through the ball
33 catcher of Figure 1 at line B-B; and

Figure 4 is a schematic view of a tool string including an embodiment of a ball catcher according to the present invention.

Reference is initially made to Figure 1 of the drawings which illustrates a ball catcher, generally indicated by reference numeral 10, in accordance with an embodiment of the present invention. Tool 10 includes a cylindrical body 12 having an upper end 14, a lower end 16 and a cylindrical bore 18 running therethrough. The body 12 has a box section 20 located at the upper end 14 and a pin section 22 located at the lower end 16 for connecting the tool 10 in a tool string, work string or drill string (not shown).

Within the cylindrical bore 18 there is located an inner cylindrical body 24. The inner body 24 fills the bore 18. Within the body 24 are two cylindrical bores, a first bore 26 and a second bore 28. Referring now to Figure 3 where the bores are shown more clearly in cross-section. The second bore 28 has a greater diameter than the first bore 26. The bores 26,28 overlap to provide a channel 30 between them. Thus an object having a diameter smaller than the width of the channel 30 can pass between the bores 26,28.

At the upper end 14 of the tool there is located a plate 32. Plate 32 can further be seen with the aid of Figure 2. Plate 32 is located across the top of the first and second bores 26,28. Plate 32 is inclined to the central bore 18. The angle of inclination is approximately 45 degrees. The low side 34 of the plate 32 is above the

1 first bore 26 and the high side 36 of the plate is above
2 the second bore 28. In this way any drop ball landing on
3 the plate 32 will fall towards the low side 34 and the

~~4 first bore 26. Plate 32 includes two circular apertures~~

5 38,40. Aperture 38 is aligned with the first bore 26 and
6 has a diameter equal to the diameter of the first bore
7 26. Aperture 40 is smaller in diameter than aperture 38
8 and smaller in diameter than the first bore 26. Thus only
9 drop balls having a diameter equal to or less than the
10 diameter of the second aperture 40 can pass through it.
11 The second aperture 40 is aligned with the second bore
12 28. In a preferred embodiment the diameter of aperture 40
13 is equal to the width of the channel 30.

14

15 Towards the lower end 16, at the bottom 42 of the first
16 bore 26, there is located a third bore 44. Third bore 44
17 is located co-axially with the first bore 26. Third bore
18 44 has a diameter which is smaller than the diameter of
19 the first bore 26. An upper surface 46 of the third bore
20 44 is also inclined, but with a low side 48 directed
21 towards the second bore 28. The surface 46 may provide a
22 keyhole profile to aid the passage of fluid through the
23 ball catcher 10.

24

25 Though the bores 26,28 are shown parallel to, but off-set
26 from the axis of the central bore 18, it will be
27 appreciated that the bores 26,28 can be located anywhere
28 in the central bore 18. Thus in a further embodiment the
29 second bore 28 is located centrally and co-axially with
30 the central bore 18 to provide a central passage running
31 axially through the ball catcher. This embodiment
32 provides for the passage of tools through the ball
33 catcher 10.

1

2 In use, ball catcher 10 is located in a tool string using
3 the box section 20 and the pin section 22. Fluid can pass
4 through the ball catcher 10 using bores 18, 28, 28 and/or
5 44, thus an unimpeded flow path is provided.

6

7 When a ball 50 enters the ball catcher 10 at the upper
8 end 14, it will be forced against plate 32. As the
9 diameter of the ball 50 is greater than the diameter of
10 the aperture 40, the ball 50 will slide down the face of
11 plate 32 and fall through aperture 38. The ball 50 then
12 falls through the first bore 26 and is prevented from
13 moving across the channel 30 to second bore 28 as its
14 diameter is greater than the width of the channel 30. At
15 the end 42 of the first bore 26, the ball 50 will be
16 stopped at the upper surface 46 of the third bore 44 as
17 the diameter of the ball 50 is greater than the diameter
18 of the third bore 44. The ball 50 is thus retained in the
19 ball catcher 10. As can be seen in Figure 1, a number of
20 balls having a similar diameter to ball 50 can be
21 retained in the ball catcher 10.

22

23 When a ball 52 enters the ball catcher 10 at the upper
24 end 14, it will be forced against plate 32. As the
25 diameter of the ball 52 is equal to the diameter of the
26 aperture 40, the ball 52 will fall through aperture 40 if
27 it meets plate 32 on the high side 36. However, if the
28 ball 52 meets the plate 32 on the low side 34, it will
29 fall through the larger aperture 40. If the ball 52 has
30 fallen through the aperture 40 it will enter the second
31 bore 28 where it has an unimpeded path through the ball
32 catcher 10 for release out of the ball catcher 10 at the
33 lower end 16. If the ball 52 falls through the aperture

10

1 38 it will pass into the ~~first~~ bore 26. From the first
2 bore 26 it may move through the channel 30 as its
3 diameter is smaller than the width of the channel 30, and
4 ~~enter the second bore 28.~~ From here the it has an
5 unimpeded path through the ball catcher 10 for release
6 out of the ball catcher 10 at the lower end 16. If the
7 ball 52 rests in the first bore 26, it can be urged into
8 the second bore by rotating the ball catcher 10 by virtue
9 of rotation of the tool string.

10

11 Thus the passage of a ball through the ball catcher is
12 selectively determined from the diameter of the ball
13 relative to the diameter of the smaller aperture 40 and
14 the width of the channel 30.

15

16 Reference is now made to Figure 4 of the drawings which
17 illustrates a tool string, generally indicated by
18 reference numeral 60, including a ball catcher 62
19 according to an embodiment of the present invention,
20 located in a well bore 64. Tool string 60 also includes a
21 drop ball activated circulation tool 66, a drop ball
22 activated packer 68 and a conventional ball catcher 70.
23 Ball catcher 62, part shown in cross-sectional view, is
24 located between the circulation tool 66 and the packer
25 68.

26

27 Ball catcher 62 is as described hereinbefore with
28 reference to Figures 1 to 3, but having the second bore
29 72 centrally located on the longitudinal axis of the tool
30 string 60. First bore 74 is thus offset from the
31 longitudinal axis.

32

11

1 Circulation tool 66 is a conventional drop ball
2 circulation tool having radially ports 76 which can
3 circulate fluid out of the tool when an inner sleeve
4 having matching radial ports is suitably aligned. The
5 inner sleeve is moved by virtue of a drop ball, the drop
6 ball being expelled from the tool after the tool has been
7 actuated. The tool may further provide cyclic circulation
8 in an on-off or off-on configuration by repeated dropping
9 of balls of a diameter which is substantially equal to
10 the diameter of the first bore 74.
11
12 Packer 68 is as known in the art and operated by virtue
13 of a drop ball having a diameter equal to or smaller than
14 the diameter of the second bore 72.
15
16 In use, the tool string 60 is run in well bore 64. At any
17 desired location either the circulation tool 66 or the
18 packer 68 can be actuated by dropping a suitable sized
19 ball into the tool string 60. Packer 68 can be operated
20 first if desired. Indeed either tool 66,68 can be
21 operated in any sequence by virtue of choice of diameter
22 of the drop ball chosen. The drop balls will be collected
23 in the ball catcher 62 if they have a diameter equal to
24 the diameter of the first bore 74 and have been used to
25 actuate the circulation tool 66. The balls will be caught
26 in the lower ball catcher 70 if they have been used to
27 actuate the packer 68. Actuation of the packer is thus
28 done from the surface of the well bore and is independent
29 of the operation of the circulation tool 66. Further as
30 the second bore 76 is located on the longitudinal axis a
31 wireline 78 can be passed through the tool string 60 to a
32 position below the ball catcher 62. Wireline 78 could be
33 a string including further tools.

12

1

2 The principal advantage of the present invention is that

3 it provides a ball catcher which can selectively retain

~~4 or allow balls to pass therethrough. A further advantage~~

5 of the present invention is that it may provide a ball

6 catcher in which a wireline or tool deploying string can

7 pass therethrough. A yet further advantage of the present

8 invention is that it provides a ball catcher which

9 permits a drop ball actuated tool located below it to be

10 operated before a drop ball actuated tool located above

11 it.

12

13 It will be appreciated by those skilled in the art that

14 modifications may be made to the invention

15 hereindescribed without departing from the scope thereof.

16 In particular the diameter of the second bore can be of

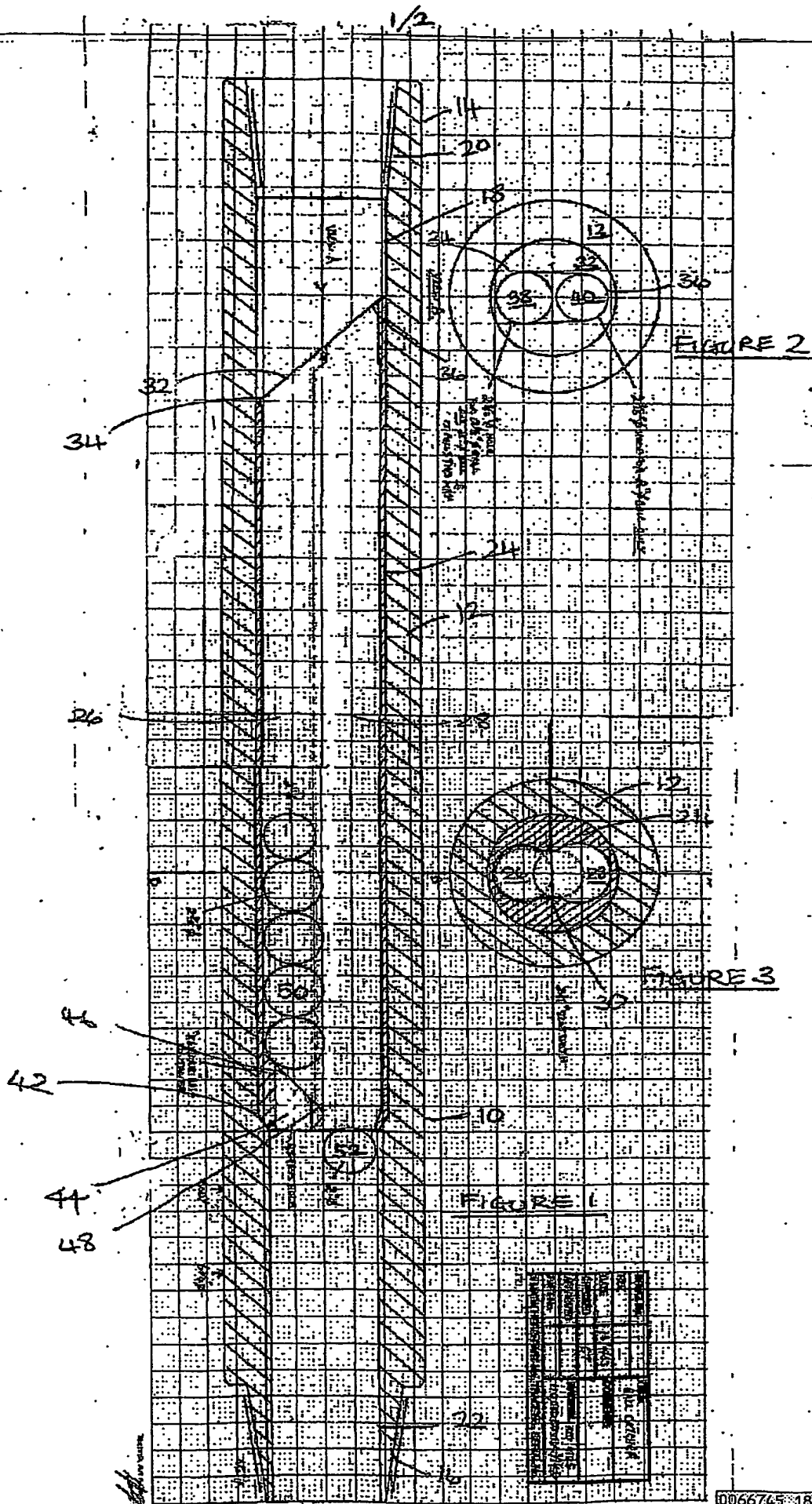
17 any diameter to suit the flow path required through the

18 ball catcher. The ball catcher may also be incorporated

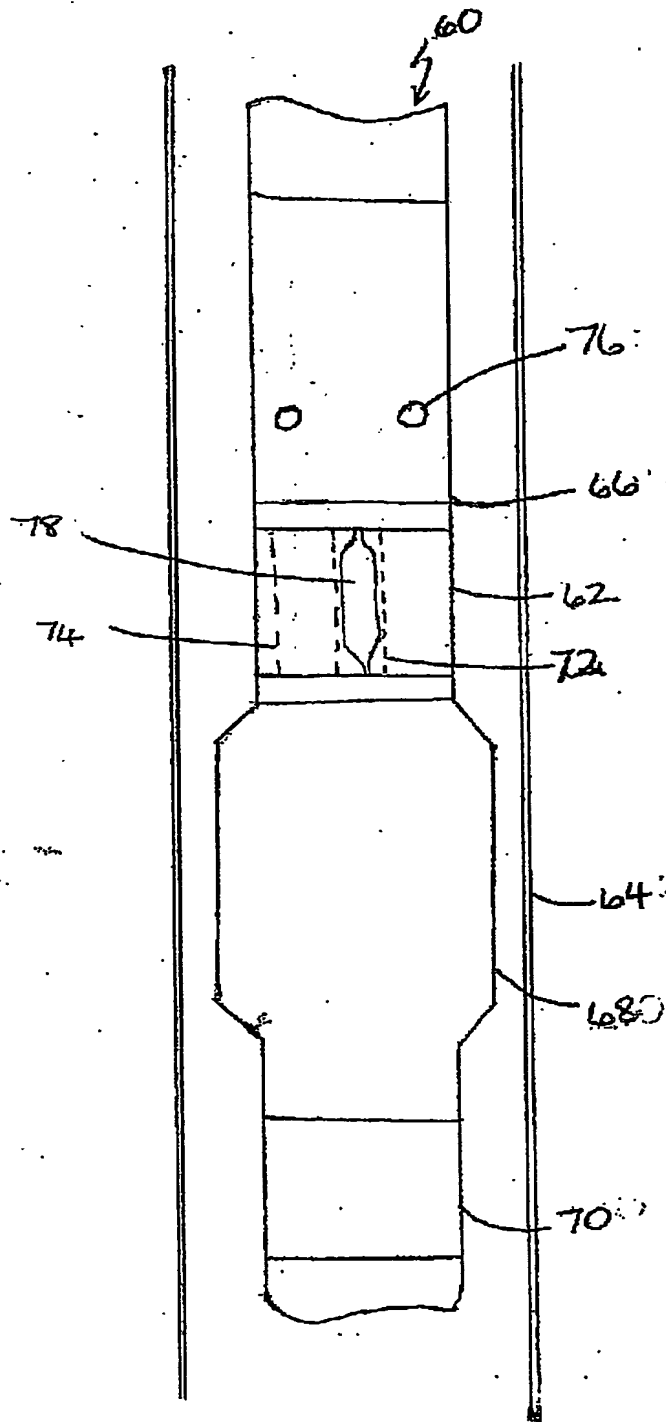
19 as an integral part of a tool to allow selective

20 operation of the tool without interrupting operation of

21 other tools located at any point on the tool string.



2/2

Fig 4.

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